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(54) MANGANESE-ZINC FERRITE CORE AND ITS MANUFACTURE

(57)Abstract:
PURPOSE: To provide a low-loss manganese-zinc ferrite core having high permeability and high resistance, and its manufacturing method.
CONSTITUTION: This core is made up of a material having a main component composed of 45-48.6mol% of Fe2O3, Mn2O3 of a molar ratio whose sum with the mole percentage of Fe2O3 is approximately 50mol%, 28-50mol% of MnO, and the remaining ZnO, and 0.01-0.5wt.% of a subcomponent including SiO2 and CaO, and Fe2+ is less than 1mol% (other than 0mol%). By making the sum of Fe2O3 and Mn2O3 approximately 50mol% in spite of Fe2O3<50mol%, perfect spinel structure can be adopted and it is beneficial to the magnetic characteristic. By selecting sintering conditions, the production of Fe2+ in a sintering process is lessened, and Mn3+ of an Mn component supplementing the shortage of Fe2O3 in place of Fe2+, and consequently the production of Fe2+ is suppressed. And it becomes possible to make the resistance higher by bringing in the grain boundary high-resistance phases of SiO2 and CaO.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the suitable manganese zinc system ferrite core for the core for deflecting yokes, and its manufacture approach.
[0002]
[Description of the Prior Art] High resistance is also increasingly required of coincidence so that it may increase rather than recent years and the former, and properties, such as high permeability (high saturation magnetic flux density) and low loss (low core loss), may be required as a core for deflecting yokes and a direct core can be looped around a coil.
[0003] In order to acquire high permeability and low loss, oxygen tension is controlled and the divalent iron ion beyond 1 mol % (Fe^{2+}) is made to generate generally using the manganese zinc (MnZn) system ferrite of an iron-oxide (Fe_2O_3) >50 mol % presentation. However, it compares with the ferrite (1x108 omega) of a Fe_2O_3 <50 mol % presentation, and resistance of the ferrite of this presentation system is 1x104. There is a fault of becoming remarkably low with omega (Table 1, 2 reference which are mentioned later). Although surface electrical resistance improves, in order that the residual stress in a front face and the interior may degrade magnetic properties in the scaling approach of that example, it becomes moreover, less practical, although high resistance-ization is also tried by this ferrite. Moreover, although the approach of coating a front face with an insulating layer is put in practical use, it serves as cost quantity.
[0004] Moreover, as a ferrite core which has high resistance, the nickel zinc (NiZn) system of a Fe_2O_3 <50 mol % presentation and the magnesium zinc (MgZn) system ferrite are put in practical use. However, the ferrite core loss of this presentation system has saturation magnetic flux density as low as 300mT(s) as compared with the MnZn system ferrite (saturation magnetic flux density = 510mT and core loss =3 kW/m3) of a Fe_2O_3 >50 mol % presentation, and a core loss is 40kW/m3. There is a fault of becoming high (Table 1, 2 reference which are mentioned later).
[0005] In addition, in the MnZn system ferrite of a Fe_2O_3 <50 mol % presentation, magnetic properties are inferior, and since sufficient value is not acquired about resistance, it is not put in practical use.
[0006] Moreover, although the purpose is different from this invention, the high density ferrite which consists of a presentation of 35 thru/or 48-mol % of Fe_2O_3, 22 or 50-mol % of MnO and, 15 thru/or 30-mol % of ZnO is known as a ferrite of a Fe_2O_3 <50 mol % presentation (JP,48-57193,A). Moreover, the ferrite core which added 1.3 thru/or 1.5-mol % of cobalt oxide to the MnZn ferrite which consists of 48 thru/or 50-mol % of Fe_2O_3, 11-mol % of ZnO and, and MnO of the remainder is also known (JP,52-4753,B official report).
[0007]
[Problem(s) to be Solved by the Invention] As mentioned above, even if it could attain high permeability and low loss, high resistance was not obtained, but since high permeability and low loss were not acquired even if it can attain high resistance, the conventional ferrite core had the problem that the high permeability and low loss which are required of the core for deflecting yokes, and high resistance could not be satisfied in recent years.
[0008] Moreover, the high density ferrite indicated by JP,48-57193,A is Fe_2O_3. Since the vacuum section is prepared and densification is carried out in the baking process in the presentation range of 35<Fe_2O_3 < 48-mol % when Mn^{3+} occupies an insufficiency, it is 104. It has stopped at omega extent. Moreover, in the presentation range of Fe_2O_3 < 45-mol %, since high saturation magnetic flux density and a low core loss are lost, practical use is not borne.
[0009] Moreover, when Mn^{3+} occupies 2OFe3 insufficiency, it sets in the presentation range of 48<Fe_2O_3 < 50-mol %, and the ferrite core indicated by the JP,52-4753,B official report is Fe_2O_3. There are many amounts, since the valence control by the above-mentioned Mn component becomes an imperfect presentation field, the amount of Fe^{2+} generation will increase rapidly, and high resistance will be spoiled.
[0010] Then, this invention is made in view of the above-mentioned situation, and aims at offering the manganese zinc

system ferrite core which has high permeability, low loss, and high resistance, and its manufacture approach.
[0011]
[Means for Solving the Problem] A manganese zinc system ferrite core according to claim 1 45 thru/or 48.6-mol % of Fe 2O3, and Fe 2O3 The principal component which the sum becomes from 50 mol Mn 2O3 of the mole ratio from which it becomes % of abbreviation, 28 or 50-mol % of MnO and, and ZnO of the remainder, SiO2 And it consists of an ingredient which has 0.01 thru/or 0.5% of the weight of the accessory constituent containing CaO, and is characterized by making Fe2+ into less than [1 mol %] (except for zero-mol %).
[0012] The manufacture approach of a manganese zinc system ferrite core according to claim 2 45 thru/or 48.6-mol % of Fe 2O3, and Fe 2O3 The principal component which the sum becomes from 50 mol Mn 2O3 of the mole ratio from which it becomes % of abbreviation, 28 or 50-mol % of MnO and, and ZnO of the remainder, SiO2 And it is the manufacture approach of a manganese zinc system ferrite core which consists of an ingredient which has 0.01 thru/or 0.5% of the weight of the accessory constituent containing CaO, and is characterized by making Fe2+ into less than [1 mol %] (except for zero-mol %) by selection of baking conditions.
[0013] The manufacture approach of a manganese zinc system ferrite core according to claim 3 calcinates the oxygen tension in the highest retention temperature at 1 thru/or 100%.
[0014]
[Function] An operation of a manganese zinc system ferrite core according to claim 1 is explained with reference to drawing 1 thru/or drawing 3 . Drawing 1 is Fe 2O3. The related Fig. of an amount and a core loss and drawing 2 are Fe 2O3. The related Fig. of an amount and saturation magnetic flux density and drawing 3 are Fe 2O3. It is a related Fig. with contact resistance.
[0015] Though it is Fe2 O 3 < 50-mol % according to the manganese zinc system ferrite core of the above-mentioned configuration, it is Fe 2O3. Mn 2O3 By making the sum into 50 mol % of abbreviation, the valence of Mn is controlled, perfect Spinel structure can be taken, and it becomes advantageous on magnetic properties. Moreover, generation of Fe2+ decreases in a baking process by selection of baking conditions, and it is Fe 2O3 instead of Fe2+. Mn3+ of Mn component with which an insufficiency is compensated is generated, and the generation of Fe2+ which causes the fall of resistance as a result is controlled. Moreover, SiO2 And high resistance-ization can be advanced by introducing the grain boundary quantity resistance phase of CaO.
[0016] In addition, when Fe2 O 3 < 45-mol %, as shown in drawing 1 , core losses (Pcv) are 12 kW/m3. Become the above, as shown in drawing 2 , saturation magnetic flux density (Bs) is set to 320 or less mTs, and it becomes impossible to attain the high saturation magnetic flux density and the low core loss which this invention makes the purpose, and practical use is not borne. 48.6 mol %<Fe 2O3 If it carries out, as shown in drawing 3 , contact resistance will fall rapidly. For this reason, Fe 2O3 It considers as 45 thru/or the 48.6-mol range of %.
[0017] Furthermore, SiO2 It is SiO2 when the accessory constituent which reaches and contains CaO is made into 0.01 or less % of the weight. And since the grain boundary quantity resistance phase of CaO affects the whole resistance, its effectiveness of a raise in resistance decreases. SiO2 And if the accessory constituent containing CaO exceeds 0.5 % of the weight, since the component which the thickness of a grain boundary phase increases, the magnetic interaction of a ferrite grain becomes weaker, and it becomes impossible to acquire outstanding magnetic properties (high saturation magnetic flux density, a low core loss, high permeability), and accomplishes a grain boundary phase has the main low melting point matter, it comes to affect the generation process and structure of a ferrite. For this reason, SiO2 And let the accessory constituent containing CaO be the above-mentioned range.
[0018] Moreover, if + exceeds Fe2 one-mol %, since migration of an electron will become easy and resistance of the ferrite itself will fall, Fe2+ is made into less than [1 mol %].
[0019] Therefore, by the above-mentioned configuration, it becomes what has the high permeability (saturation magnetic flux density) and low loss (core loss) near a MnZn system ferrite of a Fe2 O3 >50 mol % presentation, and comes to have resistance of the NiZn system ferrite of a Fe2 O3 <50 mol % presentation, and the MgZn system ferrite average.
[0020] According to the manufacture approach of a manganese zinc system ferrite core according to claim 2 By making Fe2+ into less than [1 mol %] (except for zero-mol %), the ingredient of the above-mentioned presentation ratio by selection of baking conditions It becomes what has the high permeability (saturation magnetic flux density) and low loss (core loss) near a MnZn system ferrite of a Fe2 O3 >50 mol % presentation like claim 1 publication. It comes to have resistance of the NiZn system ferrite of a Fe2 O3 <50 mol % presentation, and the MgZn system ferrite average.
[0021] According to the manufacture approach of a manganese zinc system ferrite core according to claim 3, by calcinating the oxygen tension in the highest retention temperature at 1 thru/or 100%, Fe2+ is controlled and high resistance is no longer lost. That is, the oxygen tension for satisfying less than [Fe2+1 mol %] changes with highest

retention temperature, and the highest retention temperature required for baking of a ferrite is usually 1000 thru/or 1400 degrees C, and in order to be satisfied with this temperature condition of less than [Fe2+1 mol %], it needs to perform oxygen tension at 1% or more. If oxygen tension does not reach to 1%, generation of Fe2+ will increase remarkably and resistance of the ferrite itself will fall. For this reason, oxygen tension is performed at 1% or more.
[0022]
[Example] Hereafter, the example of this invention is explained in full detail.
[0023] <Example 1> [0024] The manganese zinc (MnZn) system ferrite core of this example 1 The mole ratio (III) (Mn 2O3), for example, 1.4-mol % of manganese oxide, from which the sum with 48.6-mol % of an iron oxide (Fe 2O3), and an iron oxide (Fe 2O3) becomes 50 mol %**0.5 mol % The principal component which consists of 41-mol % of manganese oxide and (II) (MnO), and nine-mol % of a zinc oxide of the remainder (ZnO), It consists of an ingredient which has an accessory constituent containing 0.03% of the weight of a silicon dioxide (SiO2), and 0.1% of the weight of a calcium oxide (CaO), and divalent iron ion (Fe2+) is made into less than [1 mol %] (except for zero-mol %).
[0025] The 1 manufacture approach of this example 1 is explained.
[0026] First, after performing temporary baking of predetermined time for the mixed powder at 700 thru/or 1100 degrees C after carrying out weighing capacity extraction of said each powder raw material at said presentation ratio and mixing mechanically, and grinding the temporary baking powder, it corns to the grain of suitable magnitude. Thus, after carrying out pressing of the corned powder to a desired configuration, the MnZn system ferrite core of an example 1 is obtained by calcinating the Plastic solid with a batch type furnace.
[0027] As shown in drawing 4 , after they similarly perform the oxygen tension in the highest retention temperature (for example, temperature 1000 thru/or 1300 degrees C) at 1 thru/or 100 fixed% (for example, 10%) in atmospheric air for a long time (for example, 2 hours) after carrying out the temperature up of said baking conditions in atmospheric air and generate a policy objective product, in inert gas, such as atmospheric air and nitrogen, they do not change the structure of the product in the highest retention temperature, a valence, etc., and cool to a room temperature. Oxygen tension PO2 in each temperature T in order to prevent oxidation of Fe2+, Mn2+, etc. which are generated by this cooling process (balanced oxygen tension) Log(PO2 [%]) = alpha/T [**K] +beta (alpha and beta are a constant)
It is alike, and follows and controls. By this, Fe2+ can be controlled, Fe2+ can be made into less than [1 mol %], and high resistance is no longer lost. In addition, by prolonged processing which sets oxygen tension constant, valence change of an element etc. can be terminated and the target product (Spinel structure object) can be obtained.
[0028] Thus, the effectiveness of the acquired example 1 is explained with reference to Table 1. Table 1 shows the comparison of the property of an example 1 and the NiZn system ferrite core (conventional example) of a Fe2 O3 <50 mol % presentation.
[0029]
[Table 1]

フェライトコア	飽和磁束密度 [mT]	初透磁率	接触抵抗 [Ω]
実施例1	410	700	2×10^7
NiZn系フェライトコア (Fe_2O_3 <50モル%)	300	700	1×10^8

[0030] Since an example 1 can raise saturation magnetic flux density about 20% as compared with the conventional example so that clearly from this table 1, it becomes possible to offer a cheap ferrite core.
[0031] <Example 2> [0032] The MnZn system ferrite core of this example 2 47.0-mol % of Fe 2O3, and Fe 2O3 The principal component which consists of the mole ratio 2O3, for example, 3.0-mol % of Mn, from which the sum becomes 50 mol %**0.5 mol %, 34-mol % of MnO and, and 16-mol ZnO of the remainder, 0.06% of the weight of SiO2 And it consists of an ingredient which has an accessory constituent containing 0.08% of the weight of CaO, and Fe2+ is made into less than [1 mol %] (except for zero-mol %). In addition, this example 2 is manufactured like an example 1.
[0033] The effectiveness of this example 2 is explained with reference to Table 2 and drawing 5 . Table 2 shows the comparison of the property of the example 2 at the time of applying to the core for deflecting yokes, and the MnZn system ferrite core (conventional example) of the MgZn system ferrite core (conventional example) of a 50 mol % presentation, and a Fe2 O3 <Fe2O3> 50 mol % presentation. Drawing 5 is the related Fig. of the core loss and temperature rise in a CRT display.
[0034]

[Table 2]

フェライトコア	初透磁率	接触抵抗 [Ω]	コアロス 64kHz, 50mT, 100℃ [kW/m³]
実施例2	1100	3×10^{7}	5
MgZn系フェライトコア (Fe_2O_3 <50モル%)	400	1×10^{8}	40
MnZn系フェライトコア (Fe_2O_3 >50モル%)	2000	1×10^{4}	3

[0035] Since a core loss is sharply improvable as compared with the conventional example according to the example 2 so that clearly from this table 2, as shown in drawing 5 , generation of heat of the core to which it comes from RF-izing, big screen-ization, etc. in a CRT display can be reduced by about 5 degrees C compared with the conventional material.

[0036] Though it is Fe2 O 3 < 50-mol % by suitable selection of selection and the baking conditions of a mixed raw material ratio, and the oxygen tension at the time of baking according to each example explained in full detail above, it is Fe 2O3 and Mn2 O3. By making the sum into 50 mol % of abbreviation, the valence of Mn is controlled, perfect Spinel structure can be taken, and it becomes advantageous on magnetic properties. Moreover, generation of Fe2+ decreases in a baking process by selection of baking conditions, and it is Fe 2O3 instead of Fe2+. The trivalent manganese ion (Mn3+) of Mn component with which an insufficiency is compensated is generated, and the generation of Fe2+ which causes the fall of resistance as a result is controlled. Moreover, SiO2 And high resistance-ization can be advanced, a ferrite component compares with the MnZn system ferrite of a Fe2 O3 >50 mol % presentation at this time, since it is stable, it is hard to generate the mutual reaction in a grain boundary-grain, and the amount of a grain boundary phase can be made to increase by introducing the grain boundary quantity resistance phase of CaO. Consequently, 45 by which magnetic properties were inferior conventionally and resistance was also made low thru/or 48.6-mol % of Fe 2O3 In a presentation By selection of presentation design / baking conditions which make generation of Fe2+ less than [1 mol %], and positive installation of a grain boundary quantity resistance phase Since core loss reduction of the MnZn system ferrite of the Fe2 O3 <50 mol % presentation considered to be conventionally inferior by being able to realize high resistance-ization and performing oxygen tension control for antioxidizing in a cooling process was realizable It has resistance (1x107 thru/or 6x107 omega) of the NiZn system ferrite of a Fe2 O3 <50 mol % presentation, and the MgZn system ferrite average. The manganese zinc system ferrite core which has the saturation magnetic flux density (320 thru/or 410mT(s)) near a MnZn system ferrite and the core loss (5.8 thru/or 12 kW/m3) of a Fe2 O3 >50 mol % presentation, and its manufacture approach can be offered (refer to drawing 1 , drawing 2 , and drawing 3).

[0037] in addition, this invention is not limited to the above-mentioned example, but can carry out deformation implementation at versatility.

[0038]

[Effect of the Invention] According to this invention explained in full detail above, the following effectiveness is done so.

[0039] Though it is Fe2 O 3 < 50-mol % according to invention according to claim 1, it is Fe 2O3. Mn 2O3 The sum is made into 50 mol % of abbreviation. SiO2 And since the grain boundary quantity resistance phase of CaO was introduced and Fe2+ was made into less than [1 mol %] (except for zero-mol %), the manganese zinc system ferrite core which has high permeability, low loss, and high resistance can be offered.

[0040] According to invention according to claim 2, since Fe2+ is made into less than [1 mol %] (except for zero-mol %) for the ingredient of the above-mentioned presentation ratio by selection of baking conditions, the manufacture approach of the manganese zinc system ferrite core which has high permeability, low loss, and high resistance can be offered.

[0041] According to invention according to claim 3, since the oxygen tension in the highest retention temperature is calcinated at 1 thru/or 100%, Fe2+ is controlled and high resistance is no longer lost.

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] The manganese zinc system ferrite core characterized by having consisted of an ingredient characterized by providing the following, and making Fe^{2+} into less than [1 mol %] (except for zero-mol %) 45 thru/or 48.6-mol % of Fe_2O_3, and Fe_2O_3 Principal component which the sum becomes from 50 mol Mn_2O_3 of the mole ratio from which it becomes % of abbreviation, 28 or 50-mol % of MnO and, and ZnO of the remainder SiO_2 And 0.01 thru/or 0.5% of the weight of the accessory constituent containing CaO
[Claim 2] 45 thru/or 48.6-mol % of Fe_2O_3, and Fe_2O_3 Principal component which the sum becomes from 50 mol Mn_2O_3 of the mole ratio from which it becomes % of abbreviation, 28 or 50-mol % of MnO and, and ZnO of the remainder SiO_2 And 0.01 thru/or 0.5% of the weight of the accessory constituent containing CaO It is the manufacture approach of the manganese zinc system ferrite core equipped with the above, and is characterized by making Fe^{2+} into less than [1 mol %] (except for zero-mol %) by selection of baking conditions.
[Claim 3] Said baking conditions are the manufacture approach of the manganese zinc system ferrite core according to claim 2 which is what performs the oxygen tension in the highest retention temperature at 1 thru/or 100%.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Fe 2O3 Related Fig. of an amount and a core loss
[Drawing 2] Fe 2O3 Related Fig. of an amount and saturation magnetic flux density
[Drawing 3] Fe 2O3 Related Fig. with contact resistance
[Drawing 4] Drawing showing baking conditions
[Drawing 5] The related Fig. of the core loss and temperature rise in a CRT display

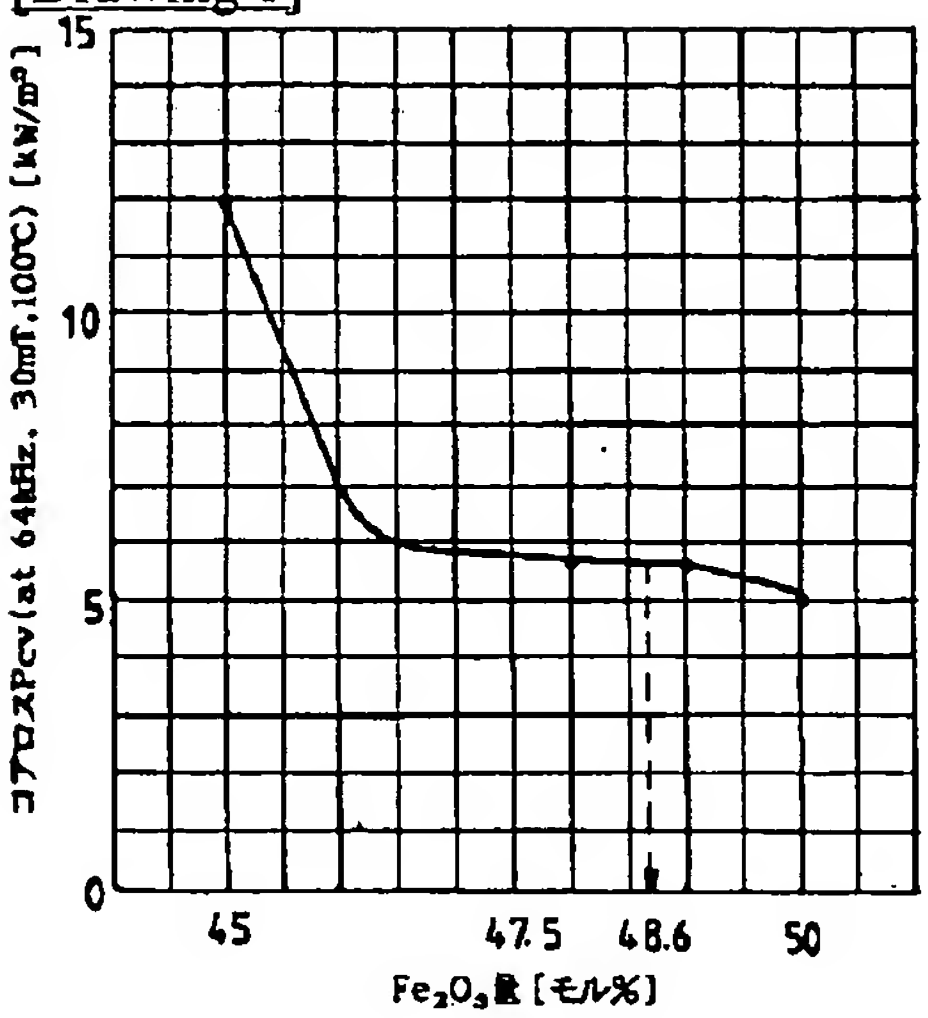
[Translation done.]

* NOTICES *

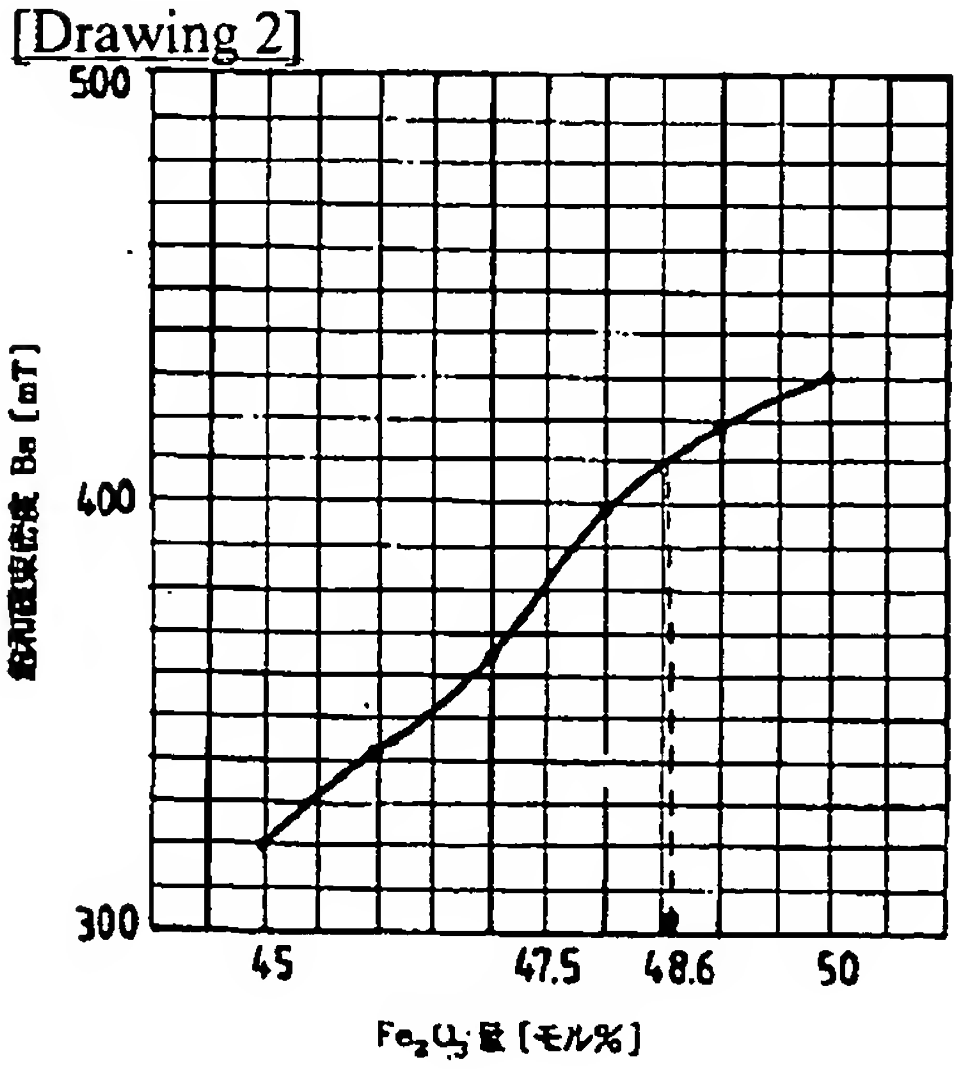
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

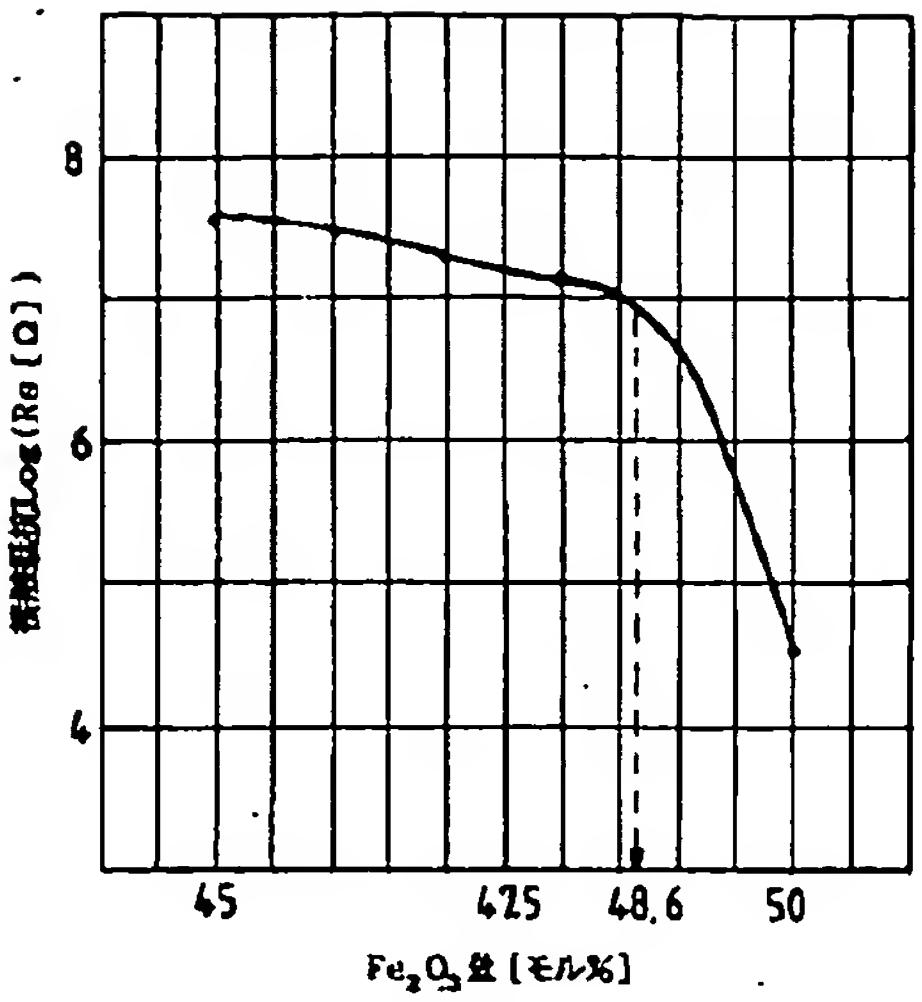
[Drawing 1]



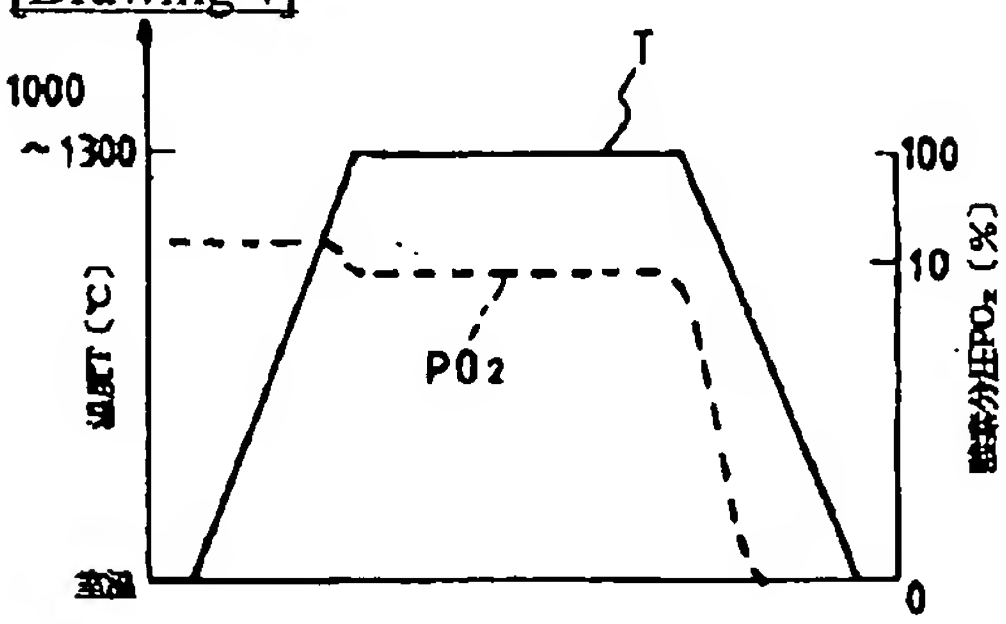
[Drawing 2]



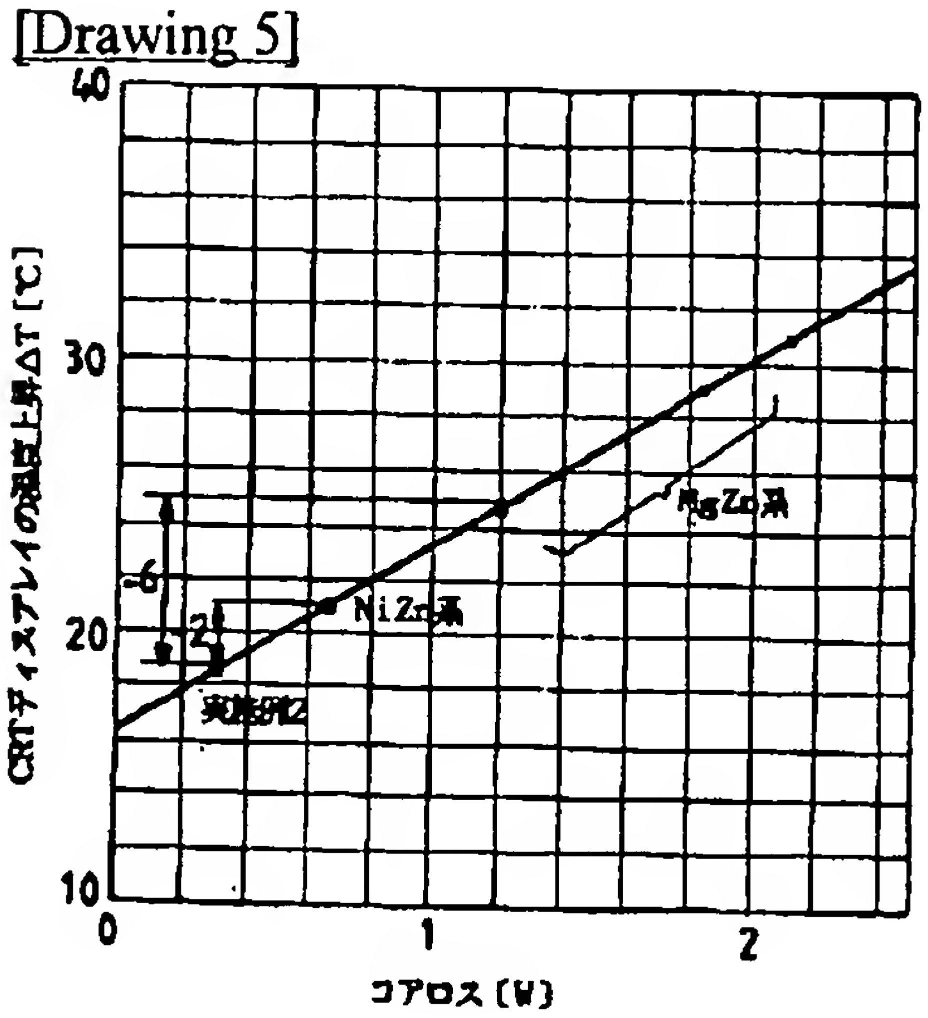
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Translation done.]

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(54)【発明の名称】　マンガン亜鉛系フェライトコア及びその製造方法

(57)【要約】

【目的】　高透磁率，低損失及び高抵抗を有するマンガン亜鉛系フェライトコア及びその製造方法を提供する。

【構成】　このコアは、45乃至48.6モル%のFe_2O_3、Fe_2O_3との和が略50モル%となるモル比のMn_2O_3、28乃至50モル%のMnO及び残部のZnOからなる主成分と、SiO_2及びCaOを含む0.01乃至0.5重量%の副成分とを有する材料からなり、Fe^{2+}を1モル%以下（0モル%を除く）としたものである。Fe_2O_3＜50モル%でありながらFe_2O_3とMn_2O_3との和を略50モル%とすることにより、完全なスピネル構造を採れ、磁気特性上有利となる。焼成条件の適定により、焼成過程でFe^{2+}の生成が

【特許請求の範囲】

【請求項1】 45乃至48.6モル%のFe_2O_3、Fe_2O_3との和が略50モル%となるモル比のMn_2O_3、28乃至50モル%のMnO及び残部のZnOからなる主成分と、SiO_2及びCaOを含む0.01乃至0.5重量%の副成分とを有する材料からなり、Fe^{2+}を1モル%以下（0モル%を除く）としたことを特徴とするマンガン亜鉛系フェライトコア。

【請求項2】 45乃至48.6モル%のFe_2O_3、Fe_2O_3との和が略50モル%となるモル比のMn_2O_3、28乃至50モル%のMnO及び残部のZnOからなる主成分と、SiO_2及びCaOを含む0.01乃至0.5重量%の副成分とを有する材料とからなるマンガン亜鉛系フェライトコアの製造方法であって、焼成条件の選定によりFe^{2+}を1モル%以下（0モル%を除く）としたことを特徴とするマンガン亜鉛系フェライトコアの製造方法。

【請求項3】 前記焼成条件は、最高保持温度における酸素分圧を1乃至100%で行うものである請求項2記載のマンガン亜鉛系フェライトコアの製造方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、偏向ヨーク用コアに好適なマンガン亜鉛系フェライトコア及びその製造方法に関する。

【0002】

【従来の技術】偏向ヨーク用コアとしては、近年、従来よりも増して高透磁率（高飽和磁束密度）、低損失（低コアロス）等の特性が要求されてきており、かつ、巻線を直接コアに巻装できるように、高抵抗も同時に要求されるようになってきている。

【0003】高透磁率及び低損失を得るためには、一般的に、酸化鉄（Fe_2O_3）>50モル%組成のマンガン亜鉛（MnZn）系フェライトを用いて、酸素分圧の制御を行い、1モル%以上の2価の鉄イオン（Fe^{2+}）を生成させている。しかしながら、この組成系のフェライトの抵抗は、Fe_2O_3<50モル%組成のフェライト（1×10^6 Ω）に比して1×10^2 Ωと著しく低くなるという欠点がある（後述する表1、2参照）。また、このフェライトで高抵抗化も試みられているが、その一例の表面酸化処理法では表面抵抗は向上するが、表面・内部における残留応力が磁気特性を劣化させてしまうため、実用的でなくなる。また、表面に絶縁層をコー

MnZn系フェライト（飽和磁束密度=510mT、コアロス=3kW/m³）に比して飽和磁束密度が300mTと低く、コアロスは40kW/m³と高くなるという欠点がある（後述する表1、2参照）。

【0005】なお、Fe_2O_3<50モル%組成のMnZn系フェライトでは、磁気特性が劣り、抵抗に関しても十分な値が得られないために実用化されていない。

【0006】また、本発明と目的が相違するが、Fe_2O_3<50モル%組成のフェライトとして、35乃至48モル%のFe_2O_3、22乃至50モル%のMnO及び15乃至30モル%のZnOの組成からなる高密度フェライトが知られている（特開昭48-57193号公報）。また、48乃至50モル%のFe_2O_3、11モル%のZnO及び残部のMnOからなるMnZnフェライトに1.3乃至1.5モル%の酸化コバルトを添加したフェライト磁心も知られている（特公昭52-4753公報）。

【0007】

【発明が解決しようとする課題】上述したように、従来のフェライトコアは、高透磁率及び低損失を達成できても高抵抗が得られず、高抵抗を達成できても高透磁率及び低損失が得られないため、近年、偏向ヨーク用コアに要求される高透磁率、低損失及び高抵抗を満足することができないという問題があった。

【0008】また、特開昭48-57193号公報に開示された高密度フェライトは、Fe_2O_3不足分をMn^{2+}が占めた場合に、35<Fe_2O_3<48モル%の組成範囲においては、焼成過程にて真空部を設け高密度化されているため10^4 Ω程度に留まっている。また、Fe_2O_3<45モル%の組成範囲においては、高飽和磁束密度及び低コアロスが失われるため、実用に耐えない。

【0009】また、特公昭52-4753公報に開示されたフェライト磁心は、Fe_2O_3不足分をMn^{2+}が占めた場合、48<Fe_2O_3<50モル%の組成範囲においては、Fe_2O_3量が多く、前述のMn成分による価数制御が不完全な組成領域となってしまうためにFe^{2+}生成量が急激に増加し高抵抗性は損なわれてしまう。

【0010】そこで、本発明は、上記事情に鑑みてなされたものであり、高透磁率、低損失及び高抵抗を有するマンガン亜鉛系フェライトコア及びその製造方法を提供することを目的とするものである。

【0011】

ことを特徴とするものである。

【0012】請求項2記載のマンガン亜鉛系フェライトコアの製造方法は、45乃至48．6モル％のFe_2O_3、Fe_2O_3との和が略50モル％となるモル比のMn_2O_3、28乃至50モル％のMnO及び残部のZnOからなる主成分と、SiO_2及びCaOを含む0．01乃至0．5重量％の副成分とを有する材料からなるマンガン亜鉛系フェライトコアの製造方法であって、焼成条件の選定によりFe^{2+}を1モル％以下（0モル％を除く）としたことを特徴とするものである。

【0013】請求項3記載のマンガン亜鉛系フェライトコアの製造方法は、最高保持温度における酸素分圧を1乃至100％で焼成を行うものである。

【0014】

【作用】請求項1記載のマンガン亜鉛系フェライトコアの作用を図1乃至図3を参照して説明する。図1はFe_2O_3量とコアロスとの関係図、図2はFe_2O_3量と飽和磁束密度との関係図、図3はFe_2O_3と接触抵抗との関係図である。

【0015】上記構成のマンガン亜鉛系フェライトコアによれば、Fe_2O_3＜50モル％でありながらFe_2O_3とMn_2O_3との和を略50モル％とすることにより、Mnの価数が制御され、完全なスピネル構造を採れ、磁気特性上有利となる。また、焼成条件の選定により、焼成過程でFe^{2+}の生成が少なくなり、Fe^{2+}の代わりにFe_2O_3の不足分を補うMn成分のMn^{3+}が生成され、結果的に抵抗の低下を招くFe^{2+}の生成が抑制される。また、SiO_2及びCaOの粒界高抵抗相を導入することにより、高抵抗化を進めることができる。

【0016】なお、Fe_2O_3＜45モル％とすると、図1に示すようにコアロス（Pcv）が12kW/m³以上となり、図2に示すように飽和磁束密度（Bs）が320mT以下となって、本発明が目的とする高飽和磁束密度及び低コアロスが達成できなくなり、実用に耐えないものとなる。48．6モル％＜Fe_2O_3とすると、図3に示すように、接触抵抗が急激に低下する。このため、Fe_2O_3を45乃至48．6モル％の範囲とする。

【0017】さらに、SiO_2及びCaOを含む副成分を0．01重量％以下とすると、SiO_2及びCaOの粒界高抵抗相は全体の抵抗に影響を与えるため、高抵抗化の効果が少なくなる。SiO_2及びCaOを含む副成分が0．5重量％を越えると、粒界相の厚みが増してフ

の移動が容易となって、フェライト自体の抵抗が低下するため、Fe^{2+}を1モル％以下とする。

【0019】従って、上記構成により、Fe_2O_3＞50モル％組成のMnZn系フェライトに近い高透磁率（飽和磁束密度）及び低損失（コアロス）を有するものとなり、Fe_2O_3＜50モル％組成のNiZn系フェライト及びMgZn系フェライト並みの抵抗を持つようになる。

【0020】請求項2記載のマンガン亜鉛系フェライトコアの製造方法によれば、上記組成比の材料を焼成条件の選定によりFe^{2+}を1モル％以下（0モル％を除く）とすることにより、請求項1記載と同様に、Fe_2O_3＞50モル％組成のMnZn系フェライトに近い高透磁率（飽和磁束密度）及び低損失（コアロス）を有するものとなり、Fe_2O_3＜50モル％組成のNiZn系フェライト及びMgZn系フェライト並みの抵抗を持つようになる。

【0021】請求項3記載のマンガン亜鉛系フェライトコアの製造方法によれば、最高保持温度における酸素分圧を1乃至100％で焼成を行うことにより、Fe^{2+}を抑制し、高抵抗性が失われなくなる。すなわち、Fe^{2+}1モル％以下を満足するための酸素分圧は、最高保持温度によって異なり、フェライトの焼成に必要な最高保持温度は、通常1000乃至1400℃であり、この温度条件でFe^{2+}1モル％以下を満足するためには、酸素分圧を1％以上で行う必要がある。酸素分圧が1％に達しないと、Fe^{2+}の生成が著しく増加してフェライト自体の抵抗が低下する。このため、酸素分圧を1％以上で行う。

【0022】

【実施例】以下、本発明の実施例を詳述する。

【0023】<実施例1>

【0024】この実施例1のマンガン亜鉛（MnZn）系フェライトコアは、48．6モル％の酸化鉄（Fe_2O_3）、酸化鉄（Fe_2O_3）との和が50モル％±0．5モル％となるモル比例えば1．4モル％の酸化マンガン（III）（Mn_2O_3）、41モル％の酸化マンガン（II）（MnO）及び残部の9モル％の酸化亜鉛（ZnO）からなる主成分と、0．03重量％の二酸化ケイ素（SiO_2）及び0．1重量％の酸化カルシウム（CaO）を含む副成分とを有する材料からなり、2価の鉄イオン（Fe^{2+}）を1モル％以下（0モル％を除く）としたものである。

施例1のMnZn系フェライトコアが得られる。

【0027】前記焼成条件は、図4に示すように、大気中で昇温した後、同じく大気中で最高保持温度（例えば温度1000乃至1300℃）における酸素分圧を一定の1乃至100%（例えば10%）で長時間（例えば2時間）行い、最終目標生成物を生成した後は、大気及び窒素等の不活性ガス中で最高保持温度における生成物の構造、価数等を変化させず室温まで冷却を行う。この冷却過程で生成されるFe^{2+}、Mn^{3+}等の酸化を防ぐために、各温度Tにおける酸素分圧（平衡酸素分圧）PO_2を

$$\mathrm{Log}(PO_2\,[\%]) = \alpha / T\,[^{\circ}K] + \beta \quad *$$

＊（α、βは定数）に従って制御する。これにより、Fe^{2+}を抑制してFe^{2+}を1モル%以下にすることができ、高抵抗性が失われなくなる。なお、酸素分圧を一定とする長時間処理により、元素の価数変化等を終了させ、目的の生成物（スピネル構造物）を得ることができる。

【0028】このようにして得られた実施例1の効果を表1を参照して説明する。表1は実施例1とFe_2O_3＜50モル%組成のNiZn系フェライトコア（従来例）との特性の比較を示すものである。

【0029】

【表1】

フェライトコア	飽和磁束密度 [mT]	初透磁率	接触抵抗 [Ω]
実施例1	410	700	2×10^7
NiZn系フェライトコア (Fe_2O_3＜50モル%)	300	700	1×10^8

【0030】この表1から明らかなように、実施例1は従来例に比して飽和磁束密度を20%程度向上させることができるので、安価なフェライトコアを提供することが可能となる。

【0031】＜実施例2＞

【0032】この実施例2のMnZn系フェライトコアは、47.0モル%のFe_2O_3、Fe_2O_3との和が50モル%±0.5モル%となるモル比例えば3.0モル%のMn_2O_3、34モル%のMnO及び残部の16モルのZnOからなる主成分と、0.06重量%のSiO_2及び0.08重量%のCaOを含む副成分とを有する材料からなり、Fe^{2+}を1モル%以下（0モル%を除※※く）としたものである。なお、この実施例2は、実施例1と同様に製造される。

【0033】この実施例2の効果を表2及び図5を参照して説明する。表2は偏向ヨーク用コアに適用した場合の実施例2とFe_2O_3＜50モル%組成のMgZn系フェライトコア（従来例）とFe_2O_3＞50モル%組成のMnZn系フェライトコア（従来例）との特性の比較を示すものである。図5はCRTディスプレイにおけるコアロスと温度上昇との関係図である。

【0034】

【表2】

フェライトコア	初透磁率	接触抵抗 [Ω]	コアロス 64kHz, 30mT, 100℃ [kW/m³]
実施例2	1100	3×10^7	5
MgZn系フェライトコア (Fe_2O_3＜50モル%)	400	1×10^8	40
MnZn系フェライトコア (Fe_2O_3＞50モル%)	2000	1×10^4	3

【0035】この表2から明らかなように、実施例2によれば、従来例と比較してコアロスを大幅に改善できる

り、Mnの価数が制御され、完全なスピネル構造を採れ、磁気特性上有利となる。また、焼成条件の選定によ

安定であるため、粒界－粒内における相互反応が発生し難く、粒界相の量を増加させることができる。この結果、従来、磁気特性が劣り抵抗も低いとされていた45乃至48.6モル%のFe_2O_3の組成において、Fe^{2+}の生成を1モル%以下とする組成設計・焼成条件の選定及び粒界高抵抗相の積極的な導入により、高抵抗化を実現でき、冷却過程における酸化防止のために酸素分圧制御を行うことにより、従来劣ると考えられていたFe_2O_3＜50モル%組成のMnZn系フェライトのコアロス低減を実現することができたので、Fe_2O_3＜50モル%組成のNiZn系フェライト及びMgZn系フェライト並みの抵抗（1×10^{7}乃至6×10^{7} Ω）を持ち、Fe_2O_3＞50モル%組成のMnZn系フェライトに近い飽和磁束密度（320乃至410mT）及びコアロス（5.8乃至12kW／m^3）を有するマンガン亜鉛系フェライトコア及びその製造方法を提供することができる（図1，図2、図3参照）。

【0037】なお、本発明は、上記実施例に限定されず、種々に変形実施できる。

【0038】

【発明の効果】以上詳述した本発明によれば、以下の効果を奏する。

【0039】請求項1記載の発明によれば、Fe_2O_3＜50モル%でありながらFe_2O_3とMn_2O_3との和を略50モル%とし、SiO_2及びCaOの粒界高抵抗相を導入し、Fe^{2+}を1モル%以下（0モル%を除く）としたので、高透磁率、低損失及び高抵抗を有するマンガン亜鉛系フェライトコアを提供することができる。

【0040】請求項2記載の発明によれば、上記組成比の材料を焼成条件の選定によりFe^{2+}を1モル%以下（0モル%を除く）としているので、高透磁率、低損失及び高抵抗を有するマンガン亜鉛系フェライトコアの製造方法を提供することができる。

【0041】請求項3記載の発明によれば、最高保持温度における酸素分圧を1乃至100%で焼成を行っているので、Fe^{2+}を抑制し、高抵抗性が失われなくなる。

【図面の簡単な説明】

【図1】Fe_2O_3量とコアロスとの関係図

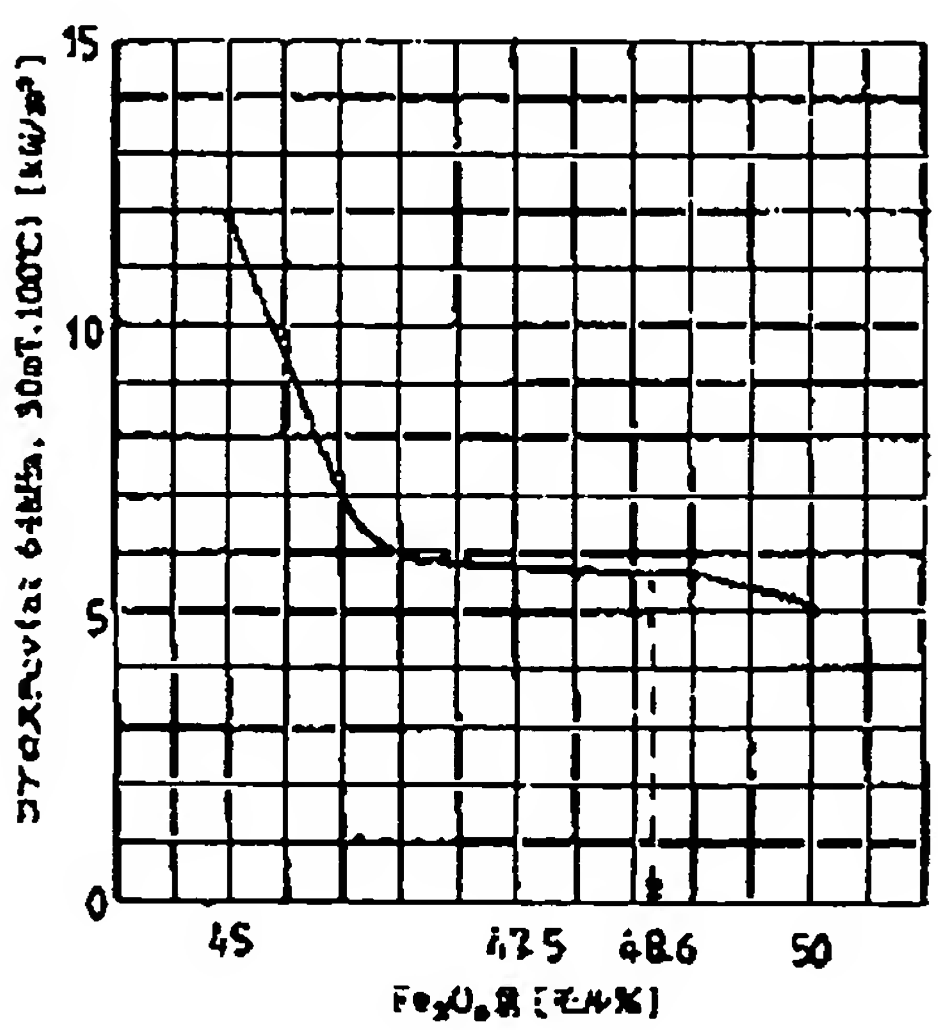
【図2】Fe_2O_3量と飽和磁束密度との関係図

【図3】Fe_2O_3と接触抵抗との関係図

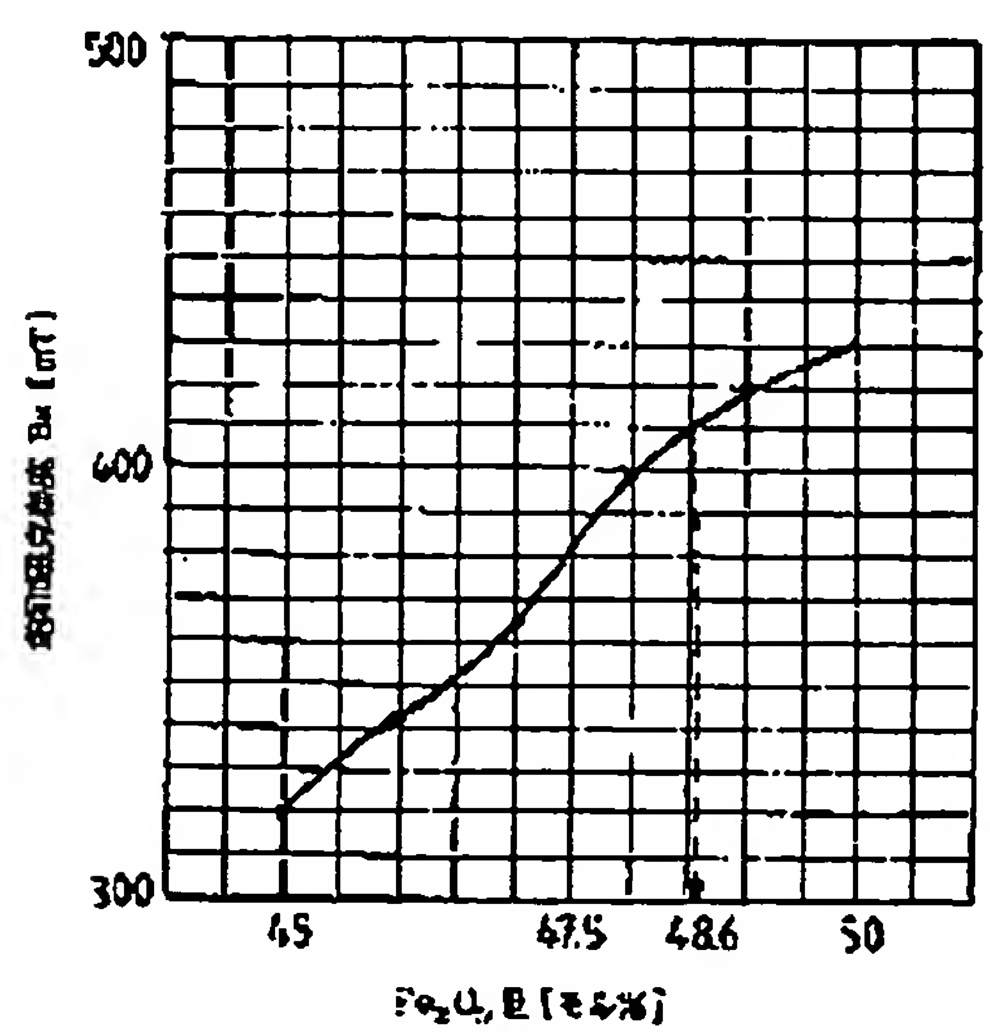
【図4】焼成条件を示す図

【図5】CRTディスプレイにおけるコアロスと温度上昇との関係図

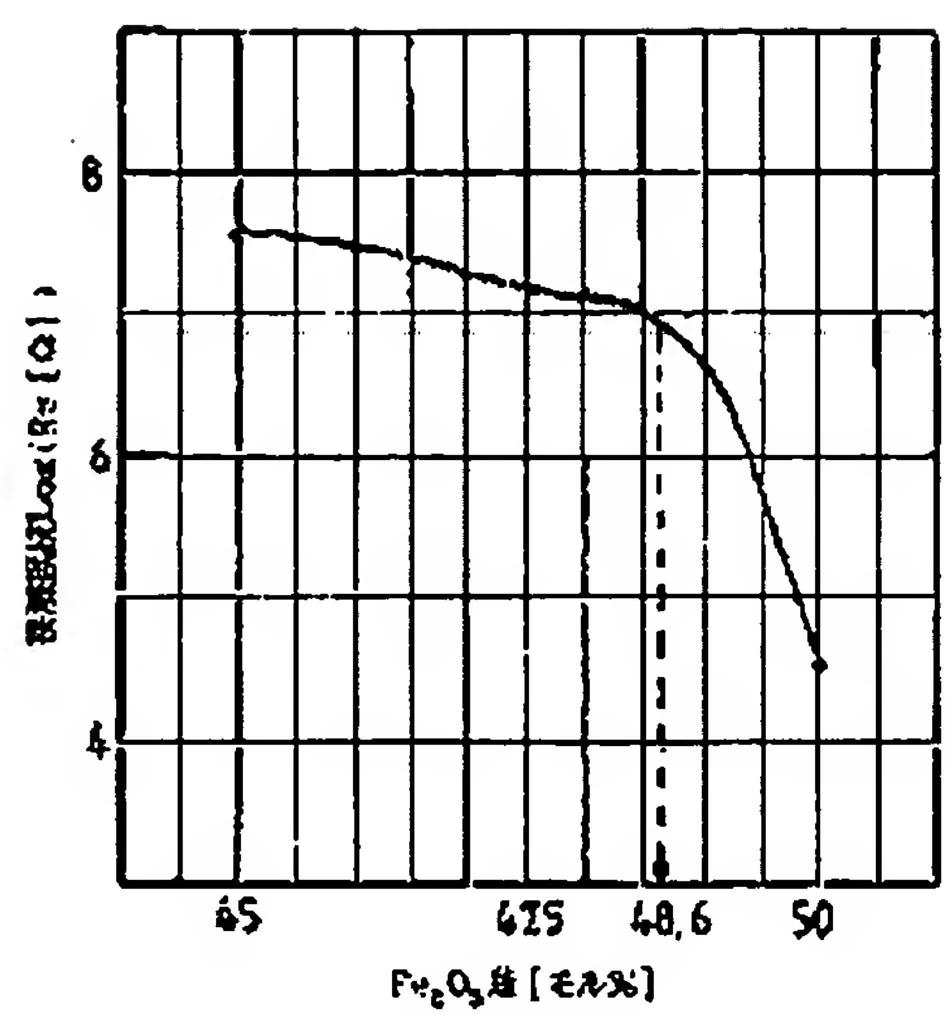
【図1】



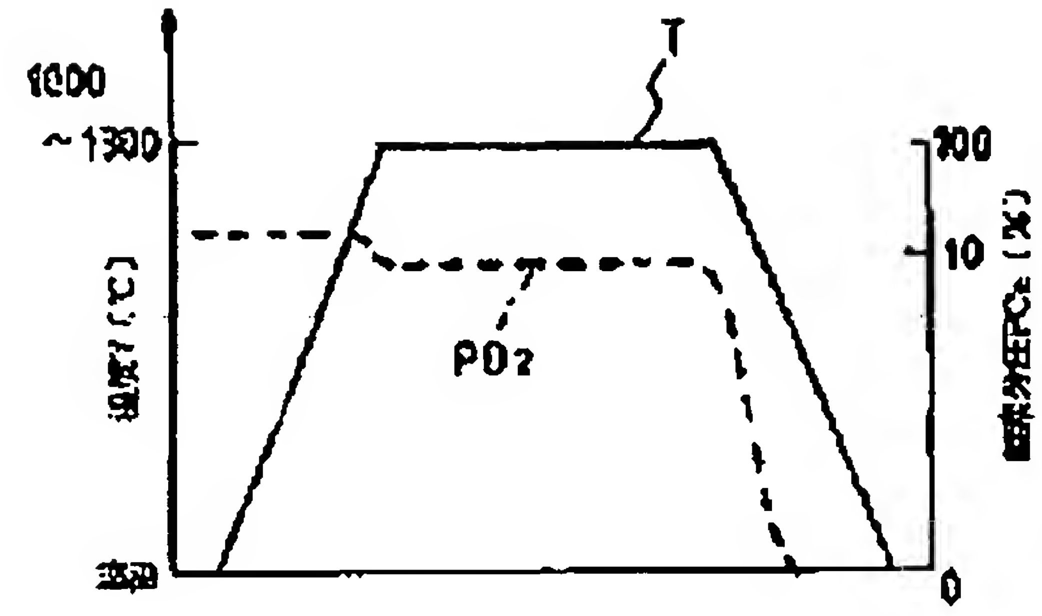
【図2】



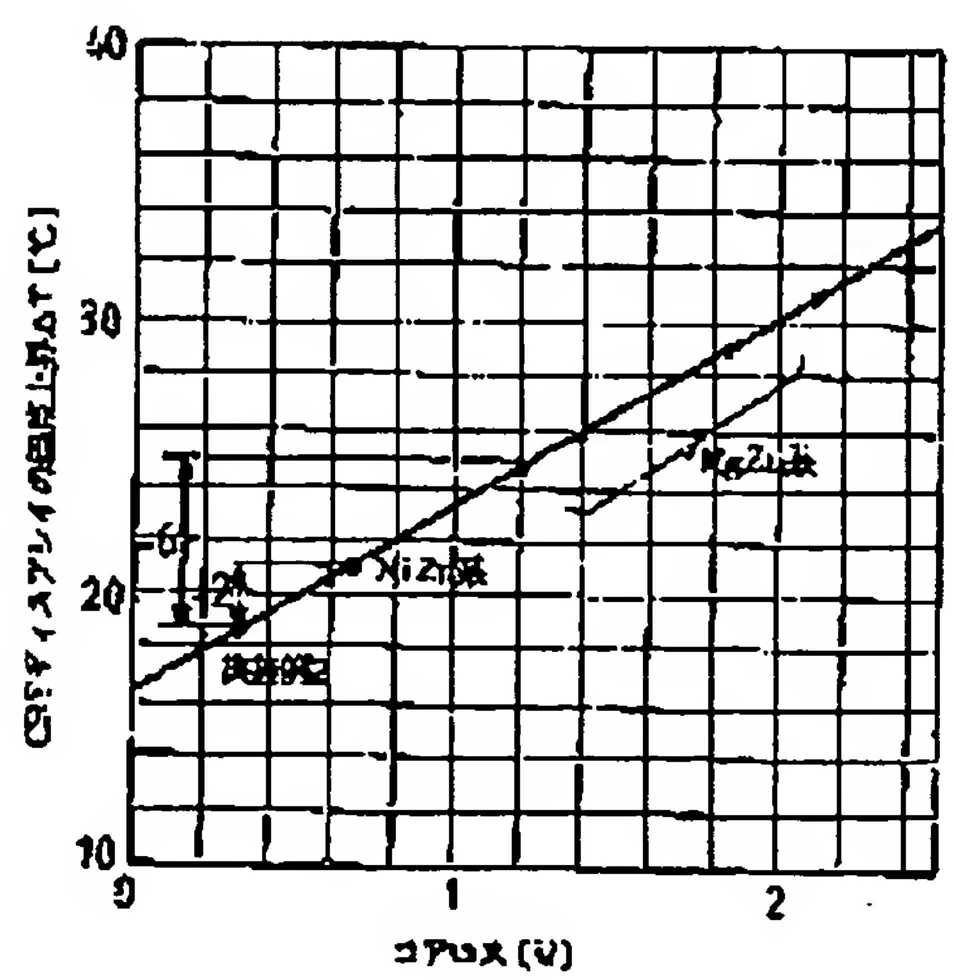
【図3】



【図4】



【図5】



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